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EXAMINER	
ALBERTALLI, BRIAN LOUIS	

ART UNIT	PAPER NUMBER
2655	

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	10/007,322	KADAMBE, SHUBHA	
	Examiner	Art Unit	
	Brian L Albertalli	2655	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-45* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6,12-17,23-28 and 34-45* is/are rejected.

7)☒ Claim(s) *7-11,18-22 and 29-33* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *6/5/02, 12/9/02*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The disclosure is objected to because of the following informalities: on page 5, line 14, one instance of the phrase "a data processing" should be deleted.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 35, 37, 39, 41, 43, and 45 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Dependent claims 35, 37, 39, 41, 43, and 45 refer to apparatus, method and computer program product for the determination of a CR bound for both an estimated mixing matrix A and a estimated signal matrix S. The claims cite a parameter λ_k^2 that is developed from a parameter W(S) that is described at one point in the specification as being either in the Fourier domain or the wavelet domain (page 26, lines 18-19). However, the parameter W(S) is also described as being solely in the wavelet domain (page 25, lines 19-21). Thus, is not clear whether the parameter W(S) is intended to limit the scope of the claims to a transform of S to the wavelet domain, or to include both the transform of S to the wavelet domain and the Fourier domain.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1-3, 12-15, and 23-25 are rejected under 35 U.S.C. 102(e) as being anticipated by Bofill et al. (*Blind Separation of More Sources Than Mixtures Using Sparsity of Their Short-Time Fourier Transform*).

6. In regard to claims 1, 12, and 23, Bofill et al. discloses an apparatus (computer) and a method for blind separation of an overcomplete (underdetermined) set of mixed signals, the apparatus comprising:

i. a data processing system including an input for receiving mixed signals from a plurality of sensors (M sensors, page 87, 1st column, section 1, line 2) configured to receive mixed signal samples comprising a mixture of signals transmitted from signal sources through an environment and noise (page 88, 1st column, lines 6-7), a signal processor attached with the input for receiving the mixed signals from the sensors, and a memory for storing data during operations of the signal processor (a computer

inherently includes a processor and a memory); the data processing system further comprising:

ii. means for storing data (computer storage device) representing the input from the sensors in a mixed signal matrix X (page 87, 1st column, section 1, lines 1-6);

iii. means for storing data (computer storage device) representing the noise in a noise matrix V (page 88, 1st column, lines 5-9);

iv. means for storing data (computer storage device) representing an estimate of the individual signals from the mixture of signals from the signal sources in a source signal estimate matrix S (page 87, 1st column, section 1, line 6 through column 2, line 1);

v. means for storing data representing an estimate of the effects of the environment in a estimated mixing matrix A where the matrices are related by X=AS+V (page 87, second column, line 1 and page 88, first column line 7);

vi. means for generating an initial estimate of the estimated mixing matrix A (assume mixing matrix A is given, page 88, 1st column, section 2, 2nd paragraph, line 1 and 5th paragraph, lines 1-3);

vii. means for determining the number of signal sources and associated lines of correlation of each of the signal sources from the estimated mixing matrix A, and for representing the signal sources in the source signal estimate matrix S (number of sources is estimated, page 89, first column, 3rd paragraph, lines 5-8);

viii. means for jointly optimizing the source signal estimate matrix and the estimated mixing matrix in an iterative manner, to generate an optimized source signal

estimate matrix and a final estimated mixing matrix (page 88, 1st column, equation 7, at each iteration, S is solved for the current estimate of A, lines 1-2 after equation 7); and

ix. means for restoring the separated source signals from the optimized source signal estimate matrix , whereby a plurality of mixed signals from unknown sources traveling through an environment with added noise may be separated so that the original, separate signals may be reconstructed (a matrix S is found, representing the underlying source signals, page 87, 1st column, section 1, line 6; which is transformed to the original domain after separation in the sparse domain, page 88, 2nd column, section 3, lines 6-11).

In regard to claims 2, 13, and 24, Bofill et al. discloses the means for generating an initial estimate of the estimated mixing matrix comprises:

i. means for transforming the mixed signal matrix X into the sparse domain using a transform operator (page 88, second column, section 3, lines 6-11);

ii. means for determining a frequency band within the sparse domain that contains the most information that can be used to determine lines of correlation to determine the number of signal sources (local maxima estimate the number of sources, page 89, first column, 3rd paragraph, lines 5-8);

iii. means for determining a measure (angle) and an optimal threshold (angular resolution) for the measure for the determination of noise within the frequency band (the angular resolution parameter adjusts the resolution of the local contributions, page 89, 1st column, lines 2-4 and 3rd paragraph, lines 1-2); and

iv. means for recalculating the measure used in the determination of the noise within the frequency band using the optimal threshold (the potential function, equation 9, is a recalculation of the angle based on the angular resolution parameter).

v. means for determining the local maxima of a distribution of the measure, where the local maxima represent angles (directions) which are inserted into the estimated mixing matrix to provide an initial estimate of the estimated mixing matrix (page 89, 1st column, third paragraph, lines 2-5).

In regard to claims 3, 14, and 25, Bofill et al. discloses:

i. means for clustering the mixed signal samples using a geometric constraint (directions, page 88, 2nd column, section 4, lines 1-4); and

ii. means for evaluating a convergence criteria based on the clustered mixed signal samples to determine whether the convergence criteria are met, and if the convergence criteria are not met, iteratively adjusting the clustering of the mixed signal samples and parameters of the geometric constraint to create a new set of clusters until the convergence criteria are met, to provide a final estimated mixing matrix (computations for the mixing matrix A are started with a coarser grid, corresponding to less convergence, then refined with a thinner grid, corresponding to more convergence, page 89, 1st column, lines 4-11).

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 5, 16, and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bofill et al.

In regard to claims 5, 16, and 27, Bofill et al. discloses:

i. means for obtaining a multi-band sparse domain estimate of the source signal estimate matrix S using the relationship X=AS+V (equation 5, sources are solved for assuming A is given, page 88, 1st column, section 2, 2nd paragraph, lines 1-4); and

ii. means for using the adjusted geometric constraint corresponding to the final estimated mixing matrix in each of the bands of the sparse domain for the source signal estimate matrix and determining whether a convergence criteria is met for the source signal estimate matrix , and if the convergence criteria are not met, iteratively adjusting the clustering of the mixed signal samples to create a new set of clusters until the convergence criteria are met, to provide a final source signal estimate matrix.

Bofill et al. discloses the source signal estimate matrix S can be optimized by calculating the solution to equation 6 iteratively for each estimate of the mixing matrix A (page 88, 1st column, equation 7, at each iteration, S is solved for the current estimate of A, lines 1-2 after equation 7).

Bofill et al. does not disclose doing this optimization in the case with noise (V). Bofill et al. only discloses performing this optimization in the absence of noise (X=AS).

It would have been obvious to one of ordinary skill in the art at the time of invention to modify Bofill et al. to perform the joint optimization of S and A in the presence of noise, using the relationship X=AS+V, since, as is well-known in the art, any communications channel generally will add noise to a signal. By performing the optimization disclosed by Bofill et al. for the noise case, the estimates of S and A would be more accurate and would reduce unwanted noise in the reconstructed signal matrix S.

9. Claims 4, 6, 15, 17, 26, and 28, are rejected under 35 U.S.C. 103(a) as being unpatentable over Bofill et al., in view of Tran et al. (U.S. Patent 6,182,018).

In regard to claims 4, 6, 15, 17, 26, and 28, Bofill et al. discloses the means for transforming the mixed signal matrix X into the sparse domain using a transform operator is a Fourier transform operator such that the estimated mixing matrix is represented in the Fourier transform (FFT transform, page 88, 2^{nd} column, section 3, 2^{nd} paragraph, lines 1-2).

Bofill et al. does not disclose the means for obtaining a multi-band sparse domain estimate of the source signal estimate matrix S using the relationship X=AS+V uses a wavelet transform operator to obtain the multi-band sparse domain estimate.

Tran et al. discloses a method and apparatus for separating sounds from a mixed signal that uses a wavelet transform operator to generate a sparse domain representation of a signal (DWT, column 4, lines 2-5).

It would have been obvious to one of ordinary skill in the art at the time of invention to modify Bofill et al. to represent the source signal matrix S in the sparse domain using a wavelet transform operator, since the wavelet transform, as opposed to the Fourier transform, allows the time versus frequency spans to be selected to maximize the performance of a given application, as taught by Tran et al. (column 3, lines 13-16).

10. Claims 34, 36, 38, 40, 42, and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bofill et al., in view of Sahlin et al. (*The Asymptotic Cramer-Rao Lower Bound for Blind Signal Separation*).

In regard to claims 34, 36, 38, 40, 42, and 44, Bofill et al. discloses an apparatus and a method for estimating a mixing matrix A and a source matrix S, the apparatus comprising a data processing system (computer) including a processor, a memory coupled to the processor (a computer inherently includes a processor and a memory, and an input coupled with the processor (microphone, page 91, 1st column, 2nd paragraph, lines 1-6). Bofill et al. further discloses that the output was listened to; therefore output (speakers or headphones) must be coupled with the processor (page 91, 2nd column, lines 13-15).

Bofill et al. does not disclose determining a CR bound for an estimated mixing matrix A, or for an estimated mixing matrix S.

Sahlin et al. discloses that a lower bound for a matrix of parameter estimates is given by the Cramer-Rao Lower Bound (page 1, 1st column, section 1, line 9 through second column, line 1).

It would have been obvious to one of ordinary skill in the art at the time of invention to modify Bofill et al. to determine a CR bound for an estimated mixing matrix A and an estimated source matrix X, in order to provide a benchmark to compare other algorithms, as taught by Sahlin et al. (page 1, 2nd column, lines 8-10).

Allowable Subject Matter

11. Claims 7-11, 18-22, and 29-33 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

Dependent claims 7, 18, and 29 refer to an apparatus, method and computer program product for blind separation of an overcomplete set of mixed signals, respectively. The prior art of record does not disclose, nor would it suggest to one of ordinary skill in the art in the recited combination, the step of determining an optimal

threshold for generating an initial estimate of a mixing matrix A by computing the entropy E(*ang*, ANG) vs. ANG; and searching for the optimal value of ANG corresponding to the minimum rate of descent of the entropy E(*ang*, ANG)

Claims 8-11, 19-22, and 30-33 would then be allowable because they further limit claims 7, 18, and 29.

12. Claims 35, 37, 39, 41, 43, and 45 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

Dependent claims 35, 37, 39, 41, 43, and 45 refer to apparatus, method and computer program product for the determination of a CR bound for both an estimated mixing matrix A and a estimated signal matrix S. The prior art of record does not disclose, nor would it suggest to one of ordinary skill in the art in the recited combination, a parameter λ_k^2 which is developed from a log likelihood function depending on a representation of the source signal S in the *wavelet* domain, W(S).

Conclusion

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Cardoso (*Separation of Non Stationary Sources*) discloses a method of calculating a CR bound for a mixing matrix A in a blind separation method. Yang (*Serial Updating Rule for Blind Separation Derived from the Method of Scoring*)

discloses calculating a Fisher information matrix in a blind separation context. Talwar et al. (*Blind Separation of Synchronous Co-Channel Digital Signals Using an Antenna Array*) discloses a method of jointly estimating a mixing matrix A and a source matrix S. Lee et al. (U.S. Patent 6,424,960) discloses a method of adapting a mixing matrix. Jourjine et al. (U.S. Patent 6,430,528) discloses a method of using a histogram to modify parameter estimates in a blind separation system.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian L Albertalli whose telephone number is (703) 305-1817. The examiner can normally be reached on Mon - Fri, 8:00 AM - 5:30 PM, every second Fri off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Talivaldis Smits can be reached on (703) 305-3011. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

BLA 10/5/04

Susan McFadden
SUSAN MCFADDEN
PRIMARY EXAMINER